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Disparities of perception on Walking Distance by Subgroups in Urban Neighbourhood Area

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Abstract

Walking distance is a subjective factor in a mode of choice. It requires empirical evidence by different types of neighbourhood subgroup perceptions. This study aims at evaluating empirically perception on walking distance to shop by several subgroups in an urban neighborhood area. Disparities perception by gender, group of ages, and house location has been investigated through their anxiety level on safety items. The result shows that anxiety level did influence perception by ages and location of houses except gender. These disparities have implications for developing strategies to enhance physical activity through walking.

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Keywords: Walking distance; urban neighbourhoods; DIF t-test; Rasch measurement model

1. Introduction

As concerns on growing traffic congestion continue to increase in communities nationwide, there is growing attention devoted to the role of environment in affecting travel behavior. Study in the fields of landscape architecture, urban planning, and transportation recommend putting destinations closer together is an essential step to reduce overall travel distance, for instance, to encourage the use of "active transportation" modes such as walking (Ewing et al., 2002; Song and Knaap, 2007, Roslina 2012). Several movements within the planning, policy, and design fields have suggested that bringing the

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destination and trip origins closer together is vital to reduce overall travel distances and travel issues. Several researchers stated that stores accessibilities can be increased by creating local shopping opportunities closer together within consumers and residential areas (Robinson, 1976, Handy, 2001). According to Evan (2003) and Roslina (2012), the walkable catchment is one of the technique used to evaluate comparative of how accessible move through an urban area in order to get to and from these centres of facilities. Researchers have agreed to set that 5 minutes walking distance is equal to radius 400 m or ¼ miles while 10 minutes walking distance is approximately radius of 800 m or ½ miles (Evan, 2003).

Distance perception is a necessary component of human interaction with the environment. As it occurs constantly during most human activity, make it one of the most ubiquitous cognitive processes known. However, to understand how close destinations residents needs for accessibility to walk becomes the central conundrum to understand the effectiveness of this strategy (Mc Comark, 2008, Agrawal, 2008). Understanding on how individual's perception of walking distance particularly to the shop dispare from the actual distance and how these perceptions vary by destination types, and socio demographic group is equally important. A vital role to the efficacy of this effort, however, lies in residents' understanding of the nearby destinations. Inclination of understanding the likely destination might miscalculate the actual distance to the destination. Therefore, it is important to know how and individual's perception of distance to destinations dispare from the real distance and how these perceptions vary by destination.

In order to explain these individual differences, an attempt relied on numerous independent proximal explanations, such as gender (Walters 1942), age (Brosvic et al. 2002) and target location (Loomis et al. 1996). Kang et al. (2003) found that customers' perception of travel time and distance to stores was more accurate as they more familiar with the endpoint of destination. Many researches on spatial analysis and stimulus-centered factors' role in distance perception supports the feature hypothesis, which believe that distances perceived as longer when there is more information to remember about an environment such as road intersections, turns, and slopes (Crompton and Andrew, 2006, Crompton et al., 2006, Cubukcu et al., 2005, Sadalla, 1980). The difference in environmental size and design of neighbourhoods perceived to impact sense of community networking functions (Siti et al., 2012).

Previous studies have investigated the phenomenon that those with anxiety trait have a disparities effect in their interpretation of the situation as well as ambiguous stimuli towards the environment. Eysenck, Macleod, and Mathews (1987) found that excessive anxiety relates with interpreting ambiguous stimuli in a threatening fashion. They also recommended that anxious participants focus their attention more on sites vacated by emotionally negative incitements. The results of these studies, as a whole, showed that anxiety – although it assumed to evoke – also has a negative memory bias, and should be assumed to have a greater impact on basic levels of processing. Hyper vigilance of high anxiety individual involves a high rate of environmental scanning, a broadening of attention prior to the detection of threat-related or task-relevant stimuli, and a narrowing of attention when such stimuli has processed (Eysenck, 1992). For instance, studies of high anxiety have revealed evidence that due to high anxiety, high anxious subjects have a lack of self-confidence, attention and integration. Thus, high anxiety can influence the perception of ambiguous stimuli, such as in the distance illusion.

Therefore, the aim for this research is to evaluate empirically perception on walking distance to shop by several subgroups in a selected neighbourhood area base on their anxiety level on safety elements mentioned in a modified version of Neighbourhood Environment Walkability Survey (NEWS). 6 variables used for anxiety level analysis are sufficient lighting, natural surveillance, crossing facilities, lighting facilities, day crime threat and night time threat. Rasch model used to examine both validity and reliability of the attributes listed. Differential Item Functioning (DIF) in Rasch measurement model analysis used to strengthen the authenticity of respondent level of anxiety in influencing people perception on distance to shop.

2. Method

2.1. Study area

A study has conducted at Taman Iskandar, Johor Bahru as shown in figure 1. Taman Iskandar is situated at the suburbs area of Johor Bahru city centre and next to Permas Jaya, that linked by the bridge of Eastern Dispersal Link Expressway (EDL). Preliminary objective measure has done by using GIS to evaluate the street connectivity index, street density and population density. Overall, Taman Iskandar founded objectively supports walking activity. The study then begins by distributing questionnaire randomly to various subgroups resident while they are walking and having activities within the neighbourhood area. A cross sectional study has conducted to determine bias perception on walking distance by different sub group. A total of 86 respondents of the neighbourhood respondent constituted to the sample and randomly selected. The sample size is ample and adequate in Rasch measurement model as to provide prediction of the data and 95% confidence level on the analysis (Linacre, 2008, Zoubir 2007, Agho, 2005).

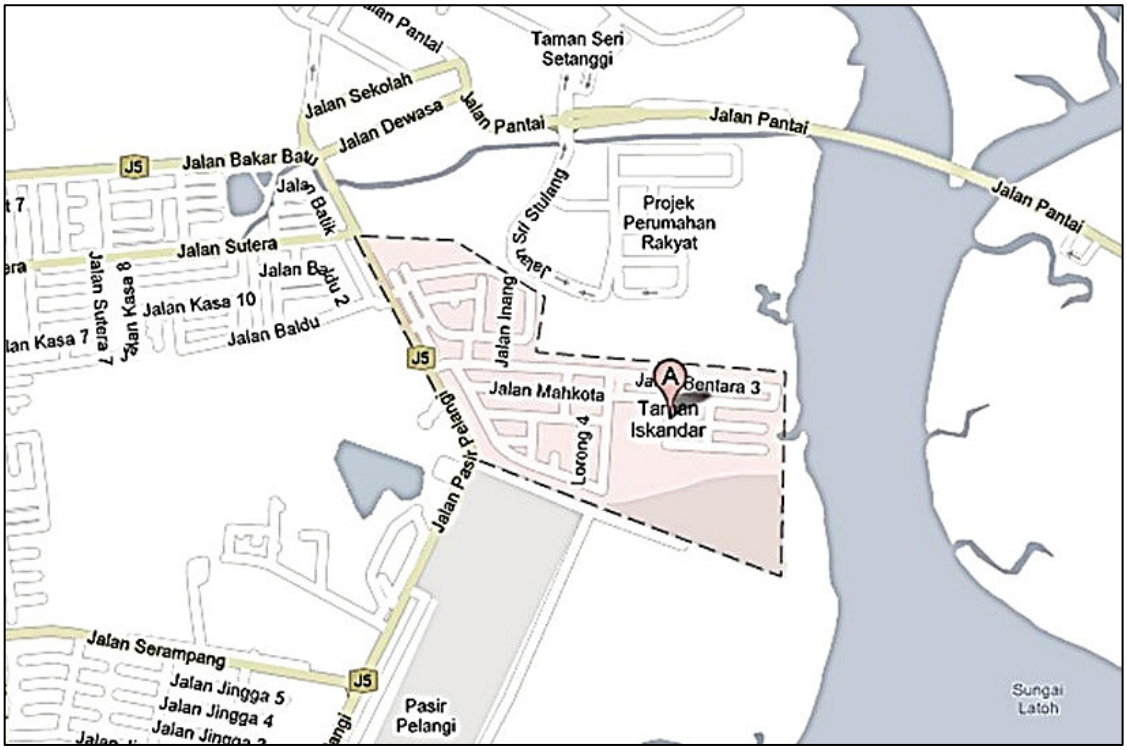

Fig. 1. Site location of studied area

2.2. Instrument construct

Questionnaire distributed querying on respondent's perception of their house distance to the shop. The anxiety level on variables listed has assessed using the same questionnaire by asking respondents perceive the level on crime threat during the day and night time. In addition, the scale comprises18 brief statement,

on a 4-point Likert scale, ranging from totally disagree (1) and totally agree (4). Factor analysis yielded high loaded factors of safety variables with good item reliability. The questionnaire comprise of 7 questions. The first question was asking on perception of distance from their house to shop. Another 6 of the questions asking on their anxiety level on this statement; natural surveillance – " I am easily to be looked as I walk along the way", sufficient lighting – "The lighting provided sufficient enough to enlighten the walkway", crossing facilities – "Easy for me to cross the road through the crossing facilities provided", lighting facilities – "There is lighting pole provided along the way", day crime threat – "I do not feel threaten on crime when I walk during the day", and night crime threat – "I do not feel threaten on crime when I walk during the night time".

3. Results

This study has designed to provide answers to two questions; (1) Are there any significant bias perception between the group of ages, gender and location of houses on their walking distance to the shop base on their anxiety level on neighbourhood safety (2) are there correlation between the way people perceive the distance and their anxiety level. The data has analysed using Winstep application to determine the validity construct validity as showed in table 1 and 2. The item reliability index is between 0 and 1 which indicate positive feedback. Item and person reliability index range between 0.8 and 1.0 logit are strongly acceptable (Bond and Fox, 2001).

Table 1. Person reliability value

	Total score	Count	Measure	Model error	Infit		Outfit	
					MNSQ	ZSTD	MNSQ	ZSTD
Mean	63.9	24.0	0.11	0.27	1.01	-0.6	1.01	-0.5
S.D	11.0	.0	0.73	0.03	0.72	2.7	0.72	2.6
Max	82.0	24.0	1.61	0.34	3.39	5.3	3.37	5.1
Min	36.0	24.0	-1.71	0.24	0.06	-5.5	0.07	-5.4

Real RMSE	0.31	True SD	0.66	Separation	2.14	Person RELIABILITY	0.82
Model RMSE	0.27	True SD	0.68	Separation	2.49	Person RELIABILITY	0.86
S.E. of Person Mean = 0.08							

Table 2. Item reliability value

	Total score	Count	Measure	Model error	Infit		Outfit	
					MNSQ	ZSTD	MNSQ	ZSTD
Mean	229.1	86.0	0.00	0.14	1.00	-0.1	1.01	-0.1
S.D	17.9	.0	0.36	0.01	0.24	1.7	0.27	1.8
Max	264.0	86.0	0.56	0.16	1.53	2.9	1.52	2.9
Min	200.0	86.0	-0.74	0.13	0.51	-4.2	0.49	-4.1

Real RMSE	0.15	True SD	0.33	Separation	2.21	Person RELIABILITY	0.83
Model RMSE	0.14	True SD	0.33	Separation	2.34	Person RELIABILITY	0.85
S.E. of Person Mean = 0.08							

Table 3 shows responses from each subgroup: gender, ages and types of houses. The number of female respondent is 38, whereas male 48. There are three subgroups for ages, 16 respondents for the age between 5 – 12 years old, 12 respondents for age 13-18 year old, 32 respondents for ages 19-40 years old and 26 respondents for subgroup ages 41-65years old. Four types of houses classified within the study area. Both single storey and double storey houses carried18 respondents. 6 respondents are living in the condominium while 44 of the total respondents living in then flat houses area.

Table 3. Detail responses for each subgroup

Subgroups	N	Subgroup	Frequency	Percentage
Gender	86	Male	48	55.81
		Female	38	44.1
Ages	86	5 -12	16	18.6
		13-18	12	13.95
		19- 40	32	37.022
		41-65	26	30.23
Types of houses	86	Single-storey	18	20.93
		Double-storey	18	20.93
		Apartment/ Condominium	6	6.97
		Flat	44	51.16

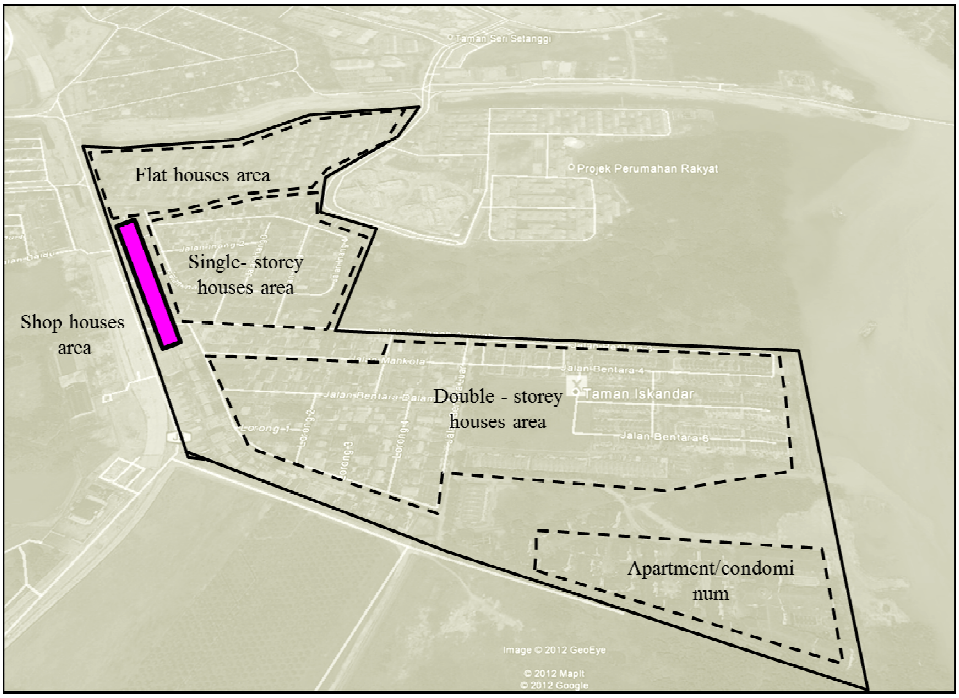

Fig. 2. Site boundary and location of shop and each type of houses

Analysis has carried out to study the existence of Differential Item Functioning (DIF) on the anxiety level on safety items for walkable neighbourhood. The DIF-t tests have run to evaluate group differences on their perception to both distances to shop and level of anxiety trait in the neighbourhood area. Fig. 2 shows the location of types of houses in the neighbourhood.

Fig. 2 and 3 shows result DIF-t plot according to perception of subgroup of ages and types of houses living on their perception on distance to the shop. The red circles represent the shop while the spider web axes denote distance of each subgroup to the target location of the shop. The perception on distance to the shop has assessed by asking their level of agreeable on this statement: “The shop provided located just nearby my house” using Likert scale range 1(totally disagree) to 4(totally agree). Fig. 3 shows perception base on types of houses regard to its location. Respondent which above the scale agree that the distance to shop is far from their house. Whereas, respondent with below the scale agree that the shops provided in their neighbourhood located just nearby to their houses. Respondent from flat houses significantly has a different perception compared than the other group with -2.56 logit. Single storey come up with -1.69logit agree that the distance to the shop is near to their house, whereas, respondent living in an apartment or condo and double storey houses perceive the other way around with logit value 1.48 and 4.56.

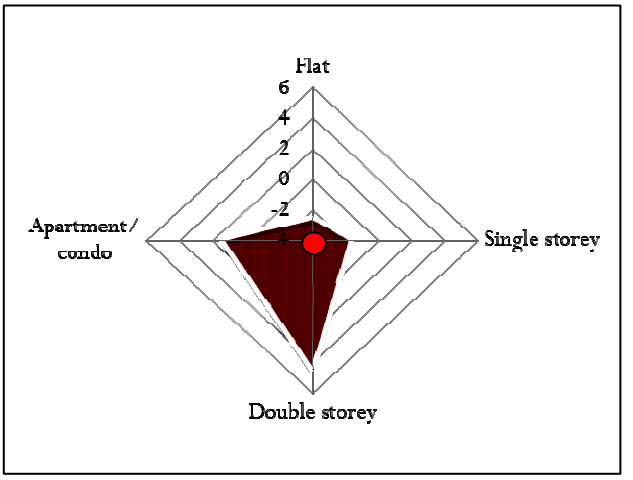

Fig. 3. DIF analysis on perception of distance to the shop base on types of houses the respondents live

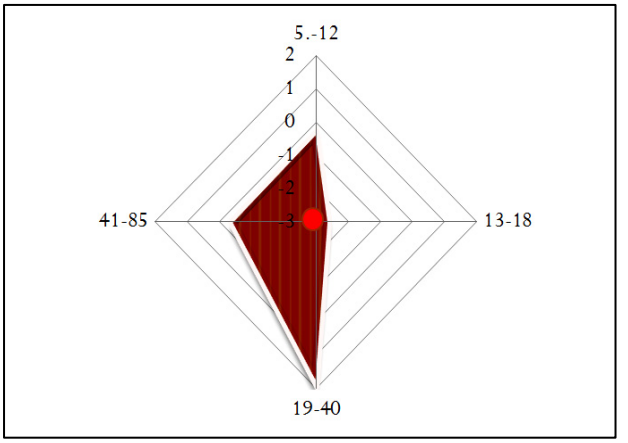

Fig. 4. DIF analysis on perception of distance to the shop base on group of ages

Table 4 shows DIF – t analysis on perception of distance to the shop and anxiety level on the physical environment - safety items. The ranking of respondent with high anxiety level on safety is above the scale whilst the ranking of respondent with low anxiety level is below the scale. Table 4 revealed that the anxiety level on natural surveillance for all houses types correlated with their perception on distance to the shop. Respondent living in flat houses with logit value -0.53 logit and -0.69 logit have a positive perception towards natural surveillance in their neighbourhood. The result was parallel with their perception on shorter distance to the shops. Meanwhile, respondent from double storey houses (1.27 logit) and condominium (0.35 logit) who have undesirable perception on natural surveillance agree that the distance to shop from their house is a bit far. Thus, it has found that the anxiety level on natural surveillance had the effect in the perception on distance for location of the houses.

Figure 4 shows disparities of perception base on the group of ages. Age 13-18 resulted significant bias of perception on shop distance as compare to other group of ages with logit value -2.59. The level of t critical value rests with value 2.0 logit for all DIF analysis (Siti, 2010). This group extremely perceives shortest distance to the shop. Group age 13- 18 and 41-85 have a positive perception on distance to shop with logit value -0.25 and -0.34. Unlikely group age 19-40 perceives longer distance to shop with logit value 1.96. Cross check on safety physical attributes revealed in table 5 show the anxiety level on day crime threat and night crime threat. This result was parallel with the perception on the shop distance.

Table 4. DIT-t analysis on perception of distance to the shop and anxiety level on physical environment - safety items

Dependent variables	Socio-economic				Age			
	n = 44	n = 18	n = 18	n = 6	n = 16	n = 12	n = 32	n = 26
	Flat	Single storey	Double storey	Apartment/ condo	5-12	13-18	19-40	41-85
Accessibility								
Shop distance	-2.56	-1.69	4.56	1.48	-0.25	-2.59	1.96	-0.34
Safety								
Sufficient lighting	0.00	0.35	1.21	-0.53	-2.09	-0.41	1.33	0.25
Natural surveillance	-0.53	-0.69	1.27	0.35	-0.49	1.06	-0.31	0.00
Crossing facilities	-0.16	0.41	-0.13	-0.06	-2.46	1.22	1.71	-0.86
Lighting facilities	-0.93	1.90	-0.47	0.08	-2.26	1.44	2.07	-1.58
Day crime threat	-0.15	0.67	-0.47	0.08	-0.27	-0.96	0.76	0.00
Night crime threat	0.63	-0.27	-0.26	-0.71	-0.35	-0.55	0.44	0.17

Table 5. DIF-t analysis on perception of distance to the shop by subgroup age and gender on physical environment - safety items

Dependent variables	Demo 1: Gender	
	Female (n = 38)	Male (n = 48)
Accessibilities		
Shop distance	-0.59	0.5
Safety		
Sufficient lighting	1.57	-1.47
Natural surveillance	1.07	-0.98
Crossing facilities	1.55	-1.43
Lighting facilities	1.53	-1.41
Day crime threat	0.70	-0.65
Night crime threat	1.26	-1.16

The DIF t-test from table 5 showed there were no significant differences between males and females on their anxiety level of the physical environment – safety items. Females have perceived shorter distance to shop with diff t- value -0.59 compared than males with logit value 0.5. However, female shows high anxiety on all listed safety items while male positively perceived safety on their neighbourhood environment. The anxiety level on gender thus had no effect in the perception of distance.

4. Discussion

The research finding revealed that there are 6 items in anxiety on safety by pedestrian specifically living in neighbourhood area that are functioning as DIF according to demographic subgroup of gender, ages and types of houses. These 6 item previously used in Neighbourhood Environment Walkability Scale (NEWS) by Saelens (2005). This research finding is in accordance with the study by (Lee, 1975, Burnett, 1975, Crompton, 2006, Cubukcu, 2005, Sadalla, 1980, Briggs, 1973) which states the presence of disparities perception of distance has connected with the factors of individual background.

The results of this study revealed that there was no significant relationship between gender perception on distance to the shop and the anxiety level of the surrounded environment. This study consistent with the result by (Baroun, 2005), who thoroughly study the perception of distance by gender using Mueller-Lyer illusion. This non-significant difference could be explained in term of the perspective theory, whereby, on the ecological hypothesis of an open area, the apparent distance in front of the respondent would be susceptible.

However, the result is inconsistent with the finding on the location of the house and ages subgroup. This research found a correlation of the anxiety level on the physical environment- safety items and distance to the shop. The DIF t-test detected that natural surveillance did influence the distance perception base on location of the houses. Technically, among all types of houses, the flat houses situated the nearest to the shop houses area. Despite of the location, it has found to have more open spaces and easily to be seen by surrounded people. Therefore, respondent from this area feel safer, probability to walk to the shop is more often, and visual perception on shorter distance to shop. According to Krizek (2007), the actual distance from an individual's home to the destination has the strongest influence on whether or not the individual knows the time it takes to walk to that destination. For instance, the closer a destination is to an individual's home, the more probably they are to correctly approximate the travel time to it.

Subgroup of ages as well is fairly accurate in perceiving distances. Lower ages, especially age group 13-18 found to be easily to perceive shorter distance compared than the elder people. This result complied

with the previous research on anxiety trait which stated that people with high anxiety trait rated their performance as low, less confidence, and perceived negative effect of their environment (Thompson et al., 2000). According to Mahmood (2009), factor that may potentially contribute to ages disparities perception is age – related differences in working memory (Holtzer, 2004, Salthouse, 1994). The longer distance or more complex tasks acquire greater demand on working memory. A lower age found to have high capacity of memory restoration (Allen et al., 2004). Therefore, this age group found to be easily to perceive shorter distance. There, studies conducted in natural environments find that perceived distance tends to be slightly underestimated when assessed by verbal reports or visual matching tasks, whereas another dependent measure, blind walking, tends to be accurate (Loomis, da Silva, Fujita, & Fukusima, 1992). Results indicated that, for shorter lengths, distances can be gauged from visual input alone with relative equivalence between older and younger participants. As distances increased, older individuals were less accurate. Studies of aging and spatial navigation indicate that elderly adults experience greater difficulty navigating in the environment than do younger individuals. The present studied indicated greater understanding of disparities perception by different subgroup in a neighbourhood area based on their perceive the level of anxiety trait of safety variables.

5. Conclusion

The results of the analyses conducted for this study show that a subgroup of the resident has disparities perception on their distance of walking. For instance, this research explains some of the large individual differences in distance estimation, which have been poorly understood. Location of the house and ages sub group did convey significant different as they have characterised by its own appeal and background. Explanation of these results is that participants with high anxiety may have some worry, self-doubts and experiences which result in procrastination and immobility in the face of possible failure. However, the anxiety level will depends on different background of the respondent. DIF t- test inspection in Rasch measurement model successfully investigate different background of resident based on gender, age, and location of the houses. Separation or exclusion of variables that are identified by DIF would increase the reliability and validity of the finding. Disparities analysis carried out on perception on distance is an effort to ascertain subgroup substantial of needs on their walkable environment. These disparities have implications for developing strategies to enhance physical activity through walking. In order to create a walkable environment, designers have to ensure the target users and their needs. Preliminary survey has to be done in a way to understand the context of the study area which might influence users' choice of transport mode. The anxiety level of people can be reduced by promoting safe environment. Additional study of the influence of the built environment on distance perception and mode choice base on different background and subgroup of people is needed. It is for better understanding how land use could be used to address transportation related to encourage walking activities.

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References

Agho, K.E, (2005). The Bootstrap Method of Rasch Conditional Item difficulty estimation. *Rasch Measurement Transaction, 19*.

Agrawal, A.W., Schlossberg, M., Irvin, K. (2008). How far, by which route and why? A spatial analysis of pedestrian preference. *J Urban Design*, *13*(1), 81–98.

Allen, G.L. et al. (2004). Aging and path integration skill: kinesthetic and vestibular contributions to wayfinding. *Perception & Psychophysics*, *66*(1), 170–9.

Brosvic, G. M., Dihoff, R.E. & Fama, J. (2002). Age-related susceptibility to the Mueller-Lyer and the horizontal– vertical illusions. *Percept. Mot. Skills, 94*, 229–234. (doi:10. 2466/PMS.94.1.229-234).

Burnett, K. P. and Briggs, R. (1975). Distance cognition and intra-urban movement. *West Lakes Meetings, Association of American Geographers. Carbondale, Illinois*, 1975.

Briggs, R. (1973). Urban cognitive distance. in Image and Environment: *Cognitive Mapping and Spatial Behavior*., R. M. Downs and D. Stea, Editors. Aldine: Chicago. 361-388.

Crompton, Andrew (2006). Perceived distance in the city as a function of time. *Environment and Behavior*, *38*(2), 173-182.

Crompton, Andrew and Frank Brown (2006). Distance estimation in a small-scale environment. *Environment and Behavior*, *38*(5), 656-666.

Cubukcu, E. and Nasar, J.L. (2005). Influence of physical characteristics of routes on distance cognition in virtual environments. *Environment and Planning B: Planning and Design*, *32*, 777-785.

Ewing, R., Rolf, P., Don, C., (2002). Measuring sprawl and its impact. *Smart Growth America, Washington, DC.*

Evan, J. (2003). Walkable towns: The liveable Neighbourhood Strategy. Sustainable transport planning for walking and cycling in urban environments. *Environmental Management*. Woodhead publishing.

Eysenck, M.W., MacLeod, C., & Mathews, A. (1987). Cognitive functioning and anxiety. *Psychological Research*, *49*(2-3), 189-195.

Eysenck, H.J. (1992). A reply to Costa and McCrae. P or A and C — the role of theory. *Personality and Individual Differences*, *13*, 867–868.

Handy, S. and Kelly, C. (2001). Local shopping as a strategy for reducing automobile travel. *Transportation*, *28*, 317-346.

Horning, J. & El-geneidy, A. Perceptions of Walking Distance to Neighborhood Retail and Other Publish Services.

Holtzer, R., Stern, Y., Rakitin, B.C. (2004) Age-related differences in executive control of working memory. *Memory & Cognition*, *32*(8), 1333–45.

Kang, Yong-Soon, Paul Herr and Christine Page (2003). Time and distance: Asymmetries in consumer trip knowledge and judgements. *Journal of Consumer Research*, *30*, 420- 429.

Lee, T. (1970). Perceived distance as a function of direction in the city. *Environment and Behavior*, *2*, 40-51.

Linacre, J. M. (2008). Development and validation of instrument. *Rasch measurement transaction*, *21*.

Loomis, J. M., Silva, J.A.D., Philbeck, J.W., Fukusima, S.S. (1996). Visual Perception of location and Distance. *American Psychological Society, 5*(3).

McCormack, G.R., Giles-Corti, B., Bulsara, M. (2008). The relationship between destination proximity, destination mix and physical activity behaviors. *Prev Med*, *46*(1), 33–40.

Robinson, R.V.F. and Vickerman, R.W. (1976). The demand for shopping travel: A theoretical and empirical study. *Applied Economics*, *8*, 267-281.

Sapawi, R. and Said, I. (2012). Constructing Indices Representing Physical Attributes for Walking in Urban Neighborhood Area. *Procedia - Social and Behavioral Sciences*, *50*, *179-189.*

Sadalla, E. K. and Staplin, L.J. (1980). The perception of traversed distance: Intersections. *Environment and Behavior, 12*(2), 167-182.

Salthouse, T.A. (1994).The aging of workingmemory. *Neuropsychology, 8*, 535–43.

Md Sakip, S.R., Johari, N. and Mohd Salleh, M.N. (2012). Sense of Community in Gated and Non-Gated Residential Neighborhoods. *Procedia - Social and Behavioral Sciences*, *50*, *818-82.*

Song, Y. and Knaap, G. (2007). Quantitative classification of neighborhoods: The neighbourhoods of new single-family homes in the Portland metropolitan area. *Journal of Urban Design*, *12*(1), 1–24.

Thompson, T., Foreman, P., & Martin, F. (2000). Impostor fears and perfectionist concern over mistakes. *Personality and Individual Differences*, 29, 629-647.

Walters, A. (1942). A genetic study of geometrical–optical illusions. Psychol. Monogr. 25, 101–155.

Mahmood, O., Adamo, D., Briceno, E., Moffat, S.D. Age differences in visual path integration. *Behaviour Brain Res*, *205*, 88–95.

Zoubir, I. I. (2007). Bootstrap Method in signal Processing, *IEEE Signal Processing Magazine*, *24*, 7-8.